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in which

$$m = \frac{b^2 + d^2 - f^2}{2b}, \quad n = \frac{c^2 + d^2 - e^2}{2c}, \quad \cos A = \frac{b^2 + c^2 - a^2}{2bc},$$

$$\sin A = \sqrt{1 - \frac{(b^2 + c^2 - a^2)^2}{4b^2c^2}}, \quad ABC = \sqrt{s(s - a)(s - b)(s - c)},$$

and similarly for *ABD, ACD* and *BCD*.

Also solved by WALTER C. EELLS and J. W. CLAWSON.

CALCULUS.

380. Proposed by C. N. SCHMALL, New York City.

Show that

$$\int_0^\infty \left[\frac{1}{1^4 + x^2} + \frac{1}{2^4 + x^2} + \frac{1}{3^4 + x^2} + \cdots\right] dx = \frac{\pi^3}{12},$$

where the series in the brackets is infinite.

SOLUTION BY A. M. HARDING, University of Arkansas.

For all values of x in the interval $(0, \infty)$ the nth term of the given series has the property

$$\frac{1}{n^4 + x^2} \leqq \frac{1}{n^4}.$$

Now the series $\sum_{n=1}^{\infty} 1/n^4$ converges. Hence, the given series is uniformly convergent in the interval $(0, \infty)$.

Each term of the series is continuous in the interval $(0, \infty)$.

Hence, it may be integrated term by term. Hence,

$$\int_0^\infty \left[\frac{1}{1^4 + x^2} + \frac{1}{2^4 + x^2} + \frac{1}{3^4 + x^2} + \cdots\right] dx = \frac{\pi}{2}\left[\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots\right].$$

It can be easily shown that

$$\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots = \frac{\pi^2}{6}.$$

Hence, the given integral $= \dfrac{\pi^3}{12}$.

Also solved by S. A. JOFFE, and J. A. CAPARO.

299. Proposed by B. F. FINKEL, Drury College.

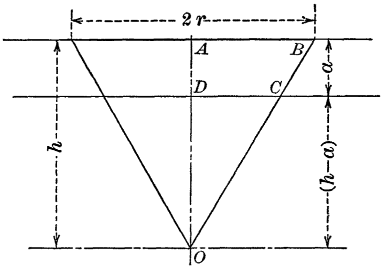
A cone rests in two fluids which do not mix, with its vertex downwards and its base in the surface of the upper fluid; to find how much its density must be increased that it may rest with its base in the common surface of the fluids. (From Walton's *Hydrostatical Problems.*)

SOLUTION BY J. F. BRACHO, University of Notre Dame.

Let, w = density of cone in first position, w_1 = density of cone in second position, d_1 = density of upper fluid, d_2 = density of lower fluid. We have:

$$DC = \frac{AB + OD}{OA} = \frac{r(h - a)}{h}.$$

By Archimedes' principle, we may write,



$$\frac{1}{3}\pi r^2 hw = \left[\frac{1}{3}\pi r^2 h - \frac{1}{3}\pi\,\frac{r^2(h-a)^3}{h^2}\right]d_1 + \frac{1}{3}\pi\,\frac{r^2(h-a)^3}{h^2}\,d_2;$$

Then,

$$w = d_1 + \frac{(h-a)^3}{h^3}(d_2 - d_1).$$

For the second position of the cone we must have,

$$w_1 = d_2.$$

Hence, increase of

$$w = w_1 - w = d_2 - d_1 - \frac{(h-a)^3}{h^3}(d_2 - d_1) = (d_2 - d_1)\left[1 - \frac{(h-a)^3}{h^3}\right].$$

QUESTIONS AND DISCUSSIONS.

Edited by U. G. Mitchell, University of Kansas.

At the time of making up copy for this issue no replies had yet been received for Questions numbered 4, 8, 12, 13, 16, 20 and 28.

REPLIES.

27. A certain college wishes to offer twelve hours of mathematics beyond the usual courses in analytic geometry and differential and integral calculus. Considering only the needs of students intending to specialize in pure mathematics, what courses should make up the twelve hours?

Note.—Last month we published a reply to this question by a professor in a middle western college. The reply given below was received while the December issue was still in press. It therefore gives an entirely independent view by an instructor in an eastern university. We hope that our readers will compare the two replies and note the points of agreement.—Editor.

Reply by R. B. Robbins, Sheffield Scientific School, Yale University.

To deal intelligently with the question it must be made more definite. Let us assume that just one year of calculus is presupposed and that an additional twelve-hour curriculum is desired which can be repeated without much modification year after year. With only the interests of prospective students of pure mathematics in mind it seems that such a college might hope to attain two fairly definite ends (I and II below) by means of the courses outlined below: